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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/676,922	10/01/2003	David E. Lowell	200309154-1	8294
22879 7590 02/06/2008 HEWLETT PACKARD COMPANY P O BOX 272400, 3404 E. HARMONY ROAD INTELLECTUAL PROPERTY ADMINISTRATION FORT COLLINS, CO 80527-2400			EXAMINER WAI, ERIC CHARLES	
			ART UNIT 2195	PAPER NUMBER
			NOTIFICATION DATE 02/06/2008	DELIVERY MODE ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary

Application No.

10/676,922

Applicant(s)

LOWELL, DAVID E.

Examiner

Eric C. Wai

Art Unit

2195

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 08 November 2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-66 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-66 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 01 October 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

1. Claims 1-66 are presented for examination.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 1-8,10,12-14,16, 29-34, 36-37, 47-51, and 53-55 are rejected under 35 U.S.C. 102(b) as being anticipated by Bugnion et al. (US Pat No. 6,075,938 hereinafter Bugnion).

4. Regarding claim 1, Bugnion teaches a computer including an I/O device, a method comprising using a virtual machine monitor to commence virtualization of the I/O device at runtime (col 2 lines 36-40).

5. Regarding claim 2, Bugnion teaches that the computer further includes a CPU, wherein the virtual machine monitor is in control of the CPU prior to the runtime virtualization of the I/O device (col 2 lines 36-40, wherein it is inherent that the VMM must virtualize the resources).

6. Regarding claim 3, Bugnion teaches that the virtualization is performed transparently to the operating system (col 6 lines 17-20).
7. Regarding claim 4, Bugnion teaches that the I/O device is compatible with the virtualized I/O device (col 6 lines 17-20, wherein they must be compatible in order for the virtualization to be transparent).
8. Regarding claim 5, Bugnion teaches that the virtualization includes commencing I/O device emulation at runtime (col 10 lines 1-2).
9. Regarding claim 6, Bugnion teaches configuring the hardware to trap I/O accesses, and enabling the virtual machine monitor to emulate the I/O device in response to the traps (col 11 lines 31-34).
10. Regarding claim 7, Bugnion teaches that the virtual machine monitor uses memory management to trap the I/O accesses (col 11 lines 31-36).
11. Regarding claim 8, Bugnion teaches that the virtual machine monitor can commence the emulation between I/O sequences (col 14 lines 32-42).
12. Regarding claim 10, Bugnion teaches that the virtual machine monitor can commence the emulation in the middle of an I/O sequence (col 14 lines 32-42).

13. Regarding claim 12, Bugnion teaches that the runtime virtualization includes using the virtual machine monitor to emulate I/O device interrupts (col 11 lines 48-49).

14. Regarding claim 13, Bugnion teaches that the I/O device interrupts are directed to the operating system prior to the runtime virtualization of the I/O device (col 2 lines 57-59); and wherein the I/O device interrupts are directed to the virtual machine monitor during and after the virtualization of the I/O device (col 11 lines 48-49).

15. Regarding claim 14, Bugnion teaches that the virtual machine monitor temporarily pauses an I/O sequence by emulating the I/O device as being busy (col 3 lines 8-10).

16. Regarding claim 16, Bugnion teaches devirtualizing the I/O device at runtime following the runtime virtualization (col 11 lines 17-19).

17. Regarding claims 29-34, and 36-37, they are the computer claims of claims 1, 4-7, 10, 12, and 14 above. Therefore they are rejected for the same reasons as claims 1, 4-7, 10, 12, and 14 above.

18. Regarding claims 47-51, and 53-55, they are the article claims of claims 1, 5-7, 10, 12, and 14 above. Therefore they are rejected for the same reasons as claims 1, 5-7, 10, 12, and 14 above.

Claim Rejections - 35 USC § 103

19. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

20. Claims 9, 11, 15, 35, and 52 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bugnion et al. (US Pat No. 6,075,938).

21. Regarding claim 9, Bugnion teaches that the virtual machine monitor commences emulation by intercepting I/O accesses (co 14 lines 32-34).

22. Bugnion does not teach that the virtual machine monitor uses the intercepted I/O accesses to change the state of a state machine, whereby the state machine reflects the state of the I/O device; and wherein the virtual machine monitor examines transitions in the state of the state machine to determine whether the I/O device is in the middle of an I/O sequence.

23. It would have been obvious to one of ordinary skill in the art at the time of the invention to include the use of a state machine. One would be motivated by the desire to have a method of representing the state of the I/O device to track its operation.

24. Regarding claim 11, Bugnion does not teach that the virtual machine monitor uses a state machine to determine whether the I/O device is in the middle of an I/O sequence, and delays commencing emulation until the state machine indicates that I/O sequence has completed.

25. It would have been obvious to one of ordinary skill in the art at the time of the invention to include the use of a state machine. One would be motivated by the desire to have a method of representing the state of the I/O device to track its operation. It also would have been obvious to delay commencing emulation. One would be motivated by the desire to not interrupt the I/O sequence.

26. Regarding claim 15, Bugnion does not teach that the I/O device has multiple modes of operations; wherein the virtual machine monitor determines the mode of the I/O device prior to commencing virtualization; and wherein the virtual machine monitor restores the determined mode of the operation after virtualization.

27. It would have been obvious to one of ordinary skill in the art at the time of the invention that I/O devices have multiple modes of operations. It also would have been obvious to restore a previous mode of operation after virtualization. One would be

motivated by the desire to ensure that the virtualization proceeded transparently as indicated by Bugnion (col 6 lines 17-20).

28. Regarding claims 35 and 52, they are the computer and article claims of claim 11 above. Therefore, they are rejected for the same reasons as claim 11 above.

29. Claims 17-28, 38-46, and 56-66 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bugnion et al. (US Pat No. 6,075,938) in view of Kozuch et al. (US Pub No. US 2002/0083110 A1 hereinafter Kozuch).

30. Regarding claim 17, Bugnion teaches a computer including hardware, a virtual machine monitor running on the hardware, an operating system running on the virtual machine monitor, the hardware including an I/O device, the I/O device already virtualized by the virtual machine monitor (col 2 lines 36-40).

31. However, Bugnion does not teach devirtualizing the I/O device at runtime. Kozuch teaches devirtualizing resources when a VMM becomes idle ([0027] lines 7-11).

32. It would have been obvious to one of ordinary skill in the art at the time of the invention, to include devirtualizing the device at runtime. One would be motivated by the desire to conserve power as indicated by Kozuch ([0027] lines 1-5).

33. Regarding claim 18, Bugnion and Kozuch do not explicitly teach that the devirtualization is performed transparently to the operating system.

34. It would have been obvious to one of ordinary skill in the art at the time of the invention that the devirtualization is performed transparently. One would be motivated by the desire to perform the devirtualization transparently since the virtualization was also performed transparently.

35. Regarding claim 19, Kozuch teaches that the devirtualization includes stopping I/O device emulation at runtime ([0027] lines 7-11).

36. Regarding claim 20, Bugnion and Kozuch do not teach that the devirtualization includes allowing the virtual machine monitor to temporarily stop the operating system from commencing a new I/O sequence.

37. It would have been obvious to one of ordinary skill in the art at the time of the invention to include temporarily stopping the OS from commencing a new I/O sequence. One would be motivated by the desire to ensure complete devirtualization before processing a new I/O request.

38. Regarding claim 21, Bugnion teaches that the virtual machine monitor temporarily stops the operating system by emulating the I/O device as being in a "busy" or "device not ready" state (col 3 lines 8-10).

39. Regarding claim 22, Bugnion and Kozuch do not teach that the virtual machine monitor bounds the amount of time the operating system processing is temporarily stopped.

40. It would have been obvious to one of ordinary skill in the art at the time of the invention that the VMM bound the amount of time that the OS is stopped. One would be motivated by the desire to ensure that the OS be stopped indefinitely.

41. Regarding claim 23, Bugnion and Kozuch do not teach that the VMM logs I/O accesses by the operating system to the I/O device during devirtualization, and replays the log to the device after devirtualization, whereby the I/O accesses by the operating system are deferred during the devirtualization of the I/O device.

42. Bugnion does teach that requests must be intercepted and remapped when virtualization of the I/O device occurs (col 2 lines 57-59). It would have been obvious to one of ordinary skill in the art at the time of the invention to that some sort of logging and playback must occur when the device is devirtualized. One would be motivated by the desire to track any requests that main occur during devirtualization..

43. Regarding claim 24, Kozuch teaches that the virtual machine monitor waits for I/Os initiated by the virtual machine monitor's driver for the I/O device to complete, and for all expected interrupts from the device to arrive, before ceasing device emulation ([0027] lines 7-11, wherein the VM must be determined to be quiescent).

44. Regarding claim 25, Bugnion and Kozuch do not teach re-directing interrupts from interrupt handlers in the-virtual machine monitor to interrupt handlers in the operating system.

45. Bugnion teaches the I/O device interrupts are directed to the virtual machine monitor during and after the virtualization of the I/O device (col 11 lines 48-49). It would have been obvious to one of ordinary skill in the art at the time of the invention, that the interrupts be redirected back to the OS during devirtualization. One would be motivated by the desire to restore the system back to its original state.

46. Regarding claim 26, Bugnion and Kozuch do not teach configuring the hardware so the accesses by the operating system to the I/O device no longer trap to the virtual machine monitor.

47. Bugnion teaches configuring the hardware to trap I/O accesses, and enabling the virtual machine monitor to emulate the I/O device in response to the traps (col 11 lines 31-34).). It would have been obvious to one of ordinary skill in the art at the time of the invention, that the I/O device no longer trap to the virtual machine monitor during devirtualization. One would be motivated by the desire to restore the system back to its original state.

48. Regarding claim 27, Bugnion and Kozuch do not teach that wherein the I/O device has multiple modes of operations; wherein the virtual machine monitor determines the mode of the I/O device prior to commencing devirtualization; and

wherein the virtual machine monitor restores the determined mode of the operation after devirtualization.

49. It would have been obvious to one of ordinary skill in the art at the time of the invention that I/O devices have multiple modes of operations. It also would have been obvious to restore a previous mode of operation after devirtualization. One would be motivated by the desire to ensure that the devirtualization proceeded transparently as indicated by Bugnion (col 6 lines 17-20).

50. Regarding claim 28, Kozuch teaches that the I/O device is virtualized at runtime again after having been devirtualized at runtime ([0031]).

51. Regarding claims 38-46, they are the computer claims of claims 17, 20-24, and 26-28 above. Therefore they are rejected for the same reasons as claims 17, 20-24, and 26-28 above.

52. Regarding claims 56-66, they are the article claims of claims 17, 19, 20-24, and 26-28 above. Therefore they are rejected for the same reasons as claims 17, 19, 20-24, and 26-28 above.

Response to Arguments

53. Applicant's arguments filed 11/08/2007 have been fully considered but they are not persuasive.

54. Applicant argues on page 12:

"In contrast, Bugnion's virtual machine monitor appears to virtualize hardware from bootup to shutdown (see col. 4, lines 24-25). As a result, overhead is incurred even when virtualization is not necessary. Thus Bugnion's VMM can add unnecessary overhead to the computer."

55. Examiner disagrees. Applicant's specification defines runtime as being the period of normal execution of the operating system after boot and before shutdown" ([0020]). Since this is the same as taught by Bugnion, Examiner fails to ascertain how Applicant's invention differs. In addition, the claims use open-ended, "comprising" language without any negative limitations, e.g. the claims allow for virtualizing/devirtualizing at boot time also.

56. Applicant argues on page 12:

"The office action cites a passage at col. 14, lines 32-34. However, that passage simply describes how an I/O device is virtualized. The passage does not describe when an I/O device is virtualized. Thus, Bugnion does not teach or suggest using a virtual machine monitor that commences virtualization of the I/O device at runtime."

57. Examiner disagrees. Claim 1 only requires that a virtual machine monitor commence virtualization of the I/O device at runtime. The limitation "at runtime" is very

broad and can be interpreted by one of ordinary skill in the art as “during runtime” or “during execution”. The cited portion of Bugnion recites, “virtual machine monitors implement in software a virtual machine identical to the underlying hardware. IBM's VM/370 system for example, allows the simultaneous execution of independent operating systems by virtualizing all the hardware resources (col 2 lines 36-40). Bugnion is very clear that it is the virtual machine monitor that commences the virtualization of hardware resources. It is inherent that a virtual machine monitor is a software program. Therefore the claims allow for a virtual machine monitor to perform the virtualization of hardware resources during its execution as a program on the computer system, e.g. during the VMM's runtime.

58. Applicant argues on page 13:

“The office action does not establish prima facie obviousness of claim 17 because it does not provide evidence that supports its conclusion. Kozuch is silent about devirtualizing an I/O device at runtime. The cited passage merely states that a virtual machine can be stopped if it is quiescent. Thus, Kozuch discloses the conventional approach of virtualizing hardware from bootup to shutdown.

The combined teachings of Bugnion and Kozuch do not teach or suggest using a virtual machine monitor to devirtualize an I/O device at runtime. Accordingly, base claim 17 and its dependent claims 18-28 should be allowed over the combined teachings of Bugnion and Kozuch.”

59. Examiner disagrees. Claim 17 requires "devirtualizing the I/O device at runtime". The limitation "at runtime" is very broad and can be interpreted by one of ordinary skill in the art as "during runtime" or "during execution". Bugnion teaches I/O devices being virtualized at runtime for the reasons presented above. Kozuch teaches devirtualizing a VM and freeing up hardware resources (i.e. I/O devices) in [0027] lines 7-11. Since the VMM is a software program that is continuously running, this devirtualizing of I/O devices is performed during its execution as a program on the computer system, e.g. during the VMM's runtime. Therefore, Bugnion and Kozuch teach the invention as claimed.

Conclusion

60. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Application/Control Number:
10/676,922
Art Unit: 2195

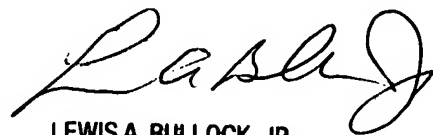
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61. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Eric C. Wai whose telephone number is 571-270-1012. The examiner can normally be reached on Mon-Thurs, 8am-5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Meng - Ai An can be reached on 571-272-3756. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

EW



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PRIMARY EXAMINER